Upstream Technology Trend
For the Future

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Digital Twin…Video
Digital Twins

- A live up-to-date digital representation of an asset, system or process
- Used to predict performance
Industrial IoT Powered by PREDIX ...Minds & Machine

Developed for Industry + 100+ years domain expertise + 550,000 digital twins = GE Advantage
IntelliStream™ Onshore… Oilfield upstream digital solution

Reduce Downtime
- 10% - 20%

Reduce Operating and Maintenance Cost
- 10% - 40%

Improve Output
- 5% - 10%

Application
- Monitoring
  - Data Integration
  - Visualization
  - KPI
  - Central Monitoring
  - Alarm Event
  - Asset Performance Management

Reliability
- Data management
- Case sharing
- Failure Diagnose

Maintenance
- Failure mode analysis
- Maintenance based on reliability
- Device maintenance strategy

Optimization
- Artificial Lifting
- Scenario analysis
- Optimize constraints
- Modeling
- Calibration

KPI Index

More modules to be released...
Improve Upstream Recovery Efficiency Through Technology Innovation

- Increase Efficiency
- Boost Production
- Reduce Cost
- Maximize ROI
- Minimize Risk
Drilling - AutoTrak™ enables the most advanced well designs
Reservoir navigation service with AutoTrak curve system

Record mile-a-day (5293 ft/day, 1613 m/day) with 100% in target zone, drilling up-dip

80+ MAD wells with 9 operators in 10 different counties in Marcellus and Utica

- Longest footage in one run: 18,024 ft (5494 m) (DJ Basin, Colorado, VCL)
- Longest lateral in one run: 13,703 ft (4177 m) (Marcellus)
- Deepest KOP TVD: 15,296 ft (4,662 m) (Woodford)
- Deepest Well TVD: 16,219 ft (4943 m) (Woodford)
- Highest 24 Hour Footage: 8,197 ft (2498 m) = 1.6 mile (Woodford)
- Fastest: 476 ft/hr (145 m/hr) (Woodford, 9,523 ft (2902 m) drilled, 1 run, L)

Total well drilled: 14,753 ft (4497 m)
Total lateral length: 13,703 ft (4177 m)
Integrated services (drill bits and drilling fluids)

Matching drill bit, BHA and drilling parameters

Mud program, solids control, monitoring drilling fluids properties during execution are key for:

• Wellbore stability
• Hole cleaning
• Avoid balling
• Allow good lubricity for longer extended laterals

Days vs. Depth Comparison to Drill Curve and Lateral Sections in the Marcellus

AutoTrak Curve

Offset

0 1 2 3 4 5 6 7 8 9 10
Total Rig Days

BHGE AutoTrak Curve System, Drill Bit and Drilling Fluids

Offset

6,500 7,500 8,500 9,500 10,500 11,500 12,500 13,500
Measured Depth (ft)
Completion Technologies for Unconventionals

- CT annular frac
- Ball drop sliding sleeve frac

Optimized Solutions for Long Laterals

**Improve efficiency**
- Using disintegrating plugs, no milling is required
- Advanced composite plugs and milling tools to reduce the operational time
- Reliable tools to reduce the risks

**Lower cost**
- Price advantage of frac plugs
- Reduce the CT cost
- Reduce perforating gun cost

**Enhance production**
- Disintegrating plugs enable longer laterals
- Advanced perforating technologies increase the connectivity
SPECTRE™ Disintegrating Plug

**Body**
- The same material of In-Tallic disintegrating ball, which has been used in more than 100,000 stages globally
- Dissolving rate is affected by salinity and temperature, can be controlled

**Element**
- Made of patented BHGE polyurethane material
- Break down into fine debris and flow back
- Dissolving rate is effected by temperature, can be controlled

**Slips**
- Advanced Nickle alloy coating technology (0.25mm - 0.38mm)
- Break down into fine debris when flow back
Completions with FracFit™ ... Reduce risk and maximize ROI

Generate optimum reservoir coverage with the right fracture conductivity along the lateral in the right intervals

- Ensure maximum reservoir contact
- Avoid geohazards

GET THE RIGHT DATA - reduce geological uncertainty and optimize completion to maximize ROI

- Producibility
- Fracability
- Geohazards
FracFit... Reducing subsurface uncertainties

**Fracability**
Mud Gas Hydrocarbons Analysis

Advanced Cuttings Evaluation:
- XRD Mineralogy & XRF ED Elements
- Pyrolysis: Kerogens, bitumens
- HC phase, Asphaltenes
- FIB-SEM, nano-scale porosity

Wireline Logging:
- Geomechanical Analysis
- Cross Dipole - Deep shear Wave Imaging
- Pulse Neutron – Mineralogy

**Hazard Avoidance**
Mud Gas Hydrocarbons Analysis

Advanced Cuttings Evaluation:
- XRD Mineralogy & XRF ED Elements

LWD and Wireline Logging:
- Cross Dipole - Deep shear Wave Imaging

**Producibility**
Mud Gas Hydrocarbons Analysis

Advanced Cuttings Evaluation and Wireline:
- XRD Mineralogy & XRF ED Elements
- Pulse Neutron – TOC
- Pyrolysis: Kerogens, bitumens
- HC phase, Asphaltenes, FIB-SEM, nano-scale porosity
BHGE ... The world’s first fullstream company for O&G industry

$23 Billion Revenue + ~70,000 employees + 120 countries + 125 year history

**UPSTREAM**
Evaluation, Drilling, Completion & Production

**MIDSTREAM**
LNG, Pipeline & Storage

**DOWNSTREAM**
Refinery & Petrochemical Solutions

Total solution provider across Oil and Gas value chain
An ecosystem open to modules and digital twin

**Fullstream digital insights on Predix, GE’s industrial platform**
Digital+ Service+ Equipment+ GE Store = Fullstream Productivity leader
Summary and Outlook
We invent smarter ways to bring energy to the world

Efficiency, cost and Capital ROI
When $50~$60 oil price becomes new normal, O&G industry needs higher efficiency, lower cost and higher capital ROI

Digital + Innovation
We are driving higher productivity and unique competence for oil and gas industry through digital and technology innovation

Baker Hughes, a GE Company
- Fullstream
- Digital + Innovation
- Global + local
- Customer orientation